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***Creating a Market for CHP – Eliminating the Barriers***

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It is a pleasure to be speaking to you today on behalf of the International Energy Agency. We applaud the initiative of the organisers of this symposium in planning an event that addresses technologies that hold enormous un-exploited potential and deserve a much more prominent position in the power supply markets. I am sure that we shall emerge from this symposium with some clearer ideas about how to transform the challenges facing combined heat and power into opportunities.

We are here today because of an acknowledged and pressing need to examine the complexities – notably complexities relating to country-specific factors – that are involved in giving CHP its rightful role in the energy system. My own task is to discuss with you the approaches that can help remove the multiple barriers that stand in the way. In my view, the overriding requirement is to ensure a “level playing field” within the power markets, and I shall return to this notion shortly.

First, however, let me say a brief word about the International Energy Agency for those unfamiliar with its role and history. The IEA is a 25-nation, inter-governmental organisation, founded in 1974 with an energy-security mandate in response to the first oil crisis. That mandate to safeguard energy security in the oil-consuming OECD nations has subsequently evolved to embrace what we call the “3Es”: Energy Security, Economic Growth and Environmental Sustainability. Drawing on its international convening power, the Agency fosters international co-operation to share energy information and develop rational energy programmes in all their aspects, including their focus on sustainability and climate concerns. CHP has for long been among the technologies that the IEA regards as offering great potential in addressing those concerns.

The origins of CHP -- or cogeneration -- date back more than a century, but its history has been chequered. On an upward growth curve until the 1930s, in part to meet inadequate electricity supplies in rural areas, the technology seems then to have lost ground due to the siting of larger and more efficient power generation units increasingly farther from urban centres. Interest in CHP was revived, however, in IEA Member countries in the mid-to-late 1970s and early 1980s by the promise of a more economical power production solution in response to the two oil shocks. The galvanising effect of the 1997 Kyoto commitments and the focus of public opinion on CO<sub>2</sub> abatement then further embellished cogeneration’s energy-efficient, clean-technology appeal. But cogeneration is vulnerable to falling fuel prices, as was seen with oil during the mid-1980s. Another recurring theme of vulnerability in its popularity rating has to do with the prevailing level of electric generating capacity, with which its electricity output has to compete.

And yet, the arguments in favour of promoting CHP as a constant high-efficiency, low-emissions component in the power-production mix are totally convincing, witness policy statements in its favour in IEA Member countries. According to the American Council for an Energy Efficient Economy, CHP is one of the five most important energy efficiency strategies for the U.S. Kyoto commitments. A U.K. study suggests that half of the CO<sub>2</sub> savings required by 2010 in the United Kingdom could be met cost-effectively with CHP. And the European Commission's view is that CHP is one of the very few technologies which can offer a significant short or medium term contribution to the energy efficiency issue in the European Union and can make a positive contribution to the environmental policies of the EU.

The United States has launched "The Combined Heat and Power Challenge, an initiative to double by 2010 the use of combined heat and power systems in commercial, industrial, and institutional buildings, and in communities throughout the United States. "A primary goal of the challenge", has declared Dan Reicher, United States Assistant Secretary for Energy Efficiency and Renewable Energy, "is to eliminate barriers that prevent more widespread adoption of combined heat and power technologies and systems". "Other goals will call attention to the role of combined heat and power in reducing air pollution by 40 million metric tons of carbon -- the equivalent of eliminating 40 million cars from U.S. roadways -- and helping to improve local economic development." A rapid calculation reveals that those 40 million cars amount to an impressive 20% of the entire United States fleet of vehicles.

The European Union, for its part, has set an objective to double CHP in EU member countries from 9% to 18% of total gross electricity generation by 2010. It is estimated that, if this increase replaced existing electricity and heat

production installations, total EU CO<sub>2</sub> emissions could be reduced by 150 Mt. per year, or approximately 4% of the total EU projected CO<sub>2</sub> emissions in 2010.

These are admirable targets. But in the absence of a “level playing field” to enable CHP to participate on equitable terms in the power markets, one can wonder if those targets are attainable. And a “level playing field” is quite distinct from anything to do with subsidies. As we know, the “playing field” in which CHP must be deployed has seen far-reaching changes in recent years. The players are no longer the traditional utilities. The rules of the game are changing, due to liberalisation and, increasingly, to globalisation, which fosters mergers and acquisitions that orient choice towards large-scale, standardized, quick pay-back solutions. CHP, including such innovative features as fuel-cell technology, is being locked out. Meanwhile, fast advancing know-how is bringing still newer generations of technology into play. Against that backdrop, a “level playing field” is more vital than ever to ensure that the competition is fair for all players, as much in the medium and long term as in the short term.

What measures have been taken by governments to smooth out that “level playing field” for cogeneration? Anybody will tell you that this or that country has introduced a set of measures to foster its market penetration. In certain countries, notably Finland, the Netherlands, Denmark and the United States, policies in place for some time have substantially supported widespread use of CHP. New steps have been taken recently, for instance in France, Germany and the United Kingdom, and we hope these will produce significant results. But there is nevertheless thin evidence of really significant market penetration on an aggregate level in the IEA nations as a whole. I am reminded of the observation made in a 1994 IEA study on cogeneration. It said the following: “The basic conclusion that can be drawn from this study is that many Member countries are anticipating significant increases in the penetration of CHP through the end of

the decade. The opportunities appear to be in those applications which have historically dominated CHP development – industry (including greenhouses) and district heating. Government policies are being aligned with these expectations. However, the benefits offered by many of these policies do not seem to explicitly or logically reward those features of CHP, specifically environmental compatibility and energy efficiency, which are used to justify policy intervention in the first place. Moreover, there is a noticeable need for additional analysis regarding the effectiveness of policies put into place.” I hope this is no longer true.

What is emerging from our evolving perspective at the IEA is that, while very specific targets for CHP integration, coupled with more coherent, better coordinated national programmes are powerful catalysts, the major problem with expanding co-generation in IEA countries lies in the fact that cogeneration is still regarded as something of a “poor relation” in the hierarchy of power production solutions, which partially explains why it is not getting a fair chance in the market. There are many possible explanations for this discriminatory attitude. One is that, in many instances, power producers seem to have been traditionally wary of becoming associated with a generating process where a portion of the output -- namely the heat produced -- was out of their control. For example, take a scenario in which a municipality sets up its own CHP plant to feed a district heating system. The problem arises of how to do business with the dominant electricity generator -- traditionally a national monopoly utility -- over selling the electricity produced or obtaining top-ups in the event of shortfalls. This scenario would place the cogenerator in an advantageous bargaining position to negotiate over the electricity sales because of his need to purchase electricity too. Ultimately, a fear of finding his options limited would discourage the power producer from entering into a business commitment with the cogenerator. The new deregulated market could well change attitudes

among power producers, but also create uncertainties for cogenerators wishing to enter the market.

Many barriers to market penetration exist and, according to the case, they may or may not be unique to CHP. Some of these barriers have developed over the years in response to a need for reliability and for diversification in fuel supply within a network where participants took equal shares in the set-up and maintenance investment. A common feature among all the barriers, however, is that they can be removed. Lamenting about barriers should be a thing of the past. Our focus should be on action in the right quarters to lift the hurdles; and the right quarters are not necessarily the offices of government policy-makers, even though individual governments can certainly play a role in creating the required market conditions. We should recognise that some barriers could be lifted by the players themselves in co-operative moves to help level out the playing field.

Let us take the example of barriers to the interconnection of new power producers to the grid so they can sell their electricity output. Interconnection requirements for electricity produced from CHP, or from any other source, are not always standardized and often involve burdensome compliance measures. I have an appeal to launch here. Working collaboratively, could cogenerators wishing to enter the market not negotiate with the grid to standardise and simplify interconnection procedures? To ensure that each new market participant can honour his commitment to provide a certain level of power to the grid, could the new players not join forces in an ad-hoc, local co-operative pooling of a given quantity of electricity resources to bridge unexpected shortfalls in a particular producer's electricity output? Such measures would eliminate discrimination against those new participants. Is there a role for the cogeneration interest groups to play in finding practical solutions to some of the

practical problems? Or could cogenerators not form local groupings to work collectively on imposing measures to smooth the way into the market?

Cogeneration offers great potential, as we know, for reducing overall emissions of pollutants and greenhouse gases. How can it be credited for replacing power output produced by less environmentally-friendly generators? Some power producers are already trading in greenhouse-gas credits, and this draws attention to their low CO<sub>2</sub> emissions. There is a clear need here for government to create a regulatory framework incorporating standard procedures, perhaps for pilot schemes, for “pre-compliance” trading of greenhouse-gas credits

The building of co-generation plants is subject, like any other construction, to official environmental permits to operate. They have to comply in terms of impact on water supplies, noise levels, land-use, visual effects or safety aspects. In many countries the authorities entrusted with granting permits are equipped to handle occasional applications from large industrial installations and not a steady flow of applications from small-scale installations. National authorities could level the playing field here by setting up model authorisation schemes to standardize and simplify requirements, thus removing the danger of bureaucratic bottle-necks.

Government and CHP support groups or trade associations could also play a useful role by creating tax advisory services to guide small, new CHP distributed power generators through the complexities of tax and depreciation regimes. Financial planning for on-site generators is often complicated because they do not always fall into a specific tax depreciation category. This is dissuasive to would-be market participants.

Finally, to ensure that information on CHP reaches potential industrial users in small-sized industry, and to reduce the cost of the technology, the notion of "technology learning" could be applied. The term means reduction of costs of a technology through the accumulation of hands-on experience. The concept is often described as "learning by doing", and it includes what we know as economies of scale. There is strong evidence across industries that experience with supplying technologies reduces prices and that there is a relatively simple, quantitative relationship between accumulated experiences and price. A well known example involves the Ford Model T, one of the first mass-produced cars. The first units were sold at a price some 2.5 to 3 times higher than the price of exactly the same model ten years later, by which time the manufacturer had accumulated the "experience" of producing some 10 million units. This clearly did not result from research into the Model T technology itself, which had scarcely changed. It was due to improvement and up-scaling of manufacturing techniques and the optimisation of many other factors of production.

This phenomenon of learning and experience in industry and business is a general one, so it is of course applicable to CHP. While CHP technology has been with us for many years, its applications are still not fully exploited, and new and increasingly dynamic markets are evolving. In a de-regulated market, it should be possible for small industry, independent power producers or municipalities to set up small-scale cost-effective installations of a capacity as low as 0.5 kWe. The size flexibility is important because it opens the way to sources of fuel not necessarily available in large quantities, such as biofuels. Large potential also exists for stirling engines and fuel cells, whose own technological development will benefit from the learning process. With more widely dispersed and vastly more numerous power-generating facilities, we are likely to see an expanding role for new actors such as power traders, also traders in greenhouse-gas emissions. Information and communication technologies will open doors to new plant-management techniques, and we could even



imagine seeing mini-CHP units being remote controlled via the Internet or cellular phones. All this means that, while CHP may be regarded as a “mature” technology, the history of its development and its multiple applications is far from over.

In the general effort to facilitate the progress of CHP, there are also advantages to exploit in Technology Procurement and other schemes where resources are pooled to foster more widespread implementation of new technology; bio-fuelled CHP plants would be good candidates, or use of fuel cells for CHP. Procurement exercises of this sort, applied to household and office equipment, as well as electrical motors for industry, have been organised within the IEA’s Demand-Side Management collaborative programme. There seems no reason why the principle could not be applied to CHP as well. Technology Public Procurements programmes can make more systematic use of the experience and learning acquired and to bring down the price of products through greater market penetration. The public image of a technology receives a massive boost if a public authority is seen to regard it as the best among other options.

There are a host of solutions to cite for lifting the built-in barriers to deployment of CHP technology. But numerous positive and motivating incentives also exist, or can be created. These can tip the balance in favour of CHP in the decision-taking process when an industrial concern is seeking new power sources, or when local authorities are in search of less costly heating systems. An example of an incentive waiting in the wings relates to the environmental appeal of CHP to a company which is comparing power-generation options. In many cases, the use of CHP resources could be highlighted as a plus-item on the company’s check-list for obtaining and maintaining certification according to EMAS or ISO 14000 environment-management system criteria. Such

certification naturally embellishes a company's profile, its marketing image and eligibility for siting and environmental permits.

Because energy policies are inevitably cross-cutting between ministries and areas of responsibility, careful scrutiny of policies and programmes at national level could well reveal ways of creating incentives. A finely-tuned and coherent policy relating to CHP would mesh with regional development objectives, with structural development targets in industry, with training and education in business, and with shifts of emphasis in the agricultural sector.

As an incentive to attract new cogenerators to the market, tariffs and rules for access to the grid should be made more transparent, also uniform between countries if possible. This is still not the case everywhere. A lack of transparency is hardly an incentive to hesitating potential market participants. There is, no doubt, a surveillance role for government here.

Opportunities for CHP can be publicised through well targeted information campaigns to enhance awareness of its benefits, and they should be made particularly attractive to the small-size cogeneration facility. Such encouragement is likely to be more effective in the long run than subsidies for CHP, offers to potential players of cash benefits or up-front financial advantages, or than the spin-off from measures to discourage specific alternative means of supplying power. There are excellent justifications for abolishing fossil-fuel subsidies, or for imposing non-fossil fuel obligations on power producers or for internalising external environmental costs through tax, but CHP is not alone in benefiting from these measures.

Timing is also crucial. An existing or new player should not be kept waiting if he is looking for incentives to modernise or create a CHP facility. Because the

pay-back time for CHP installations tends to be longer, incentives such as bankable greenhouse gas credits should foster long-term investments to prevent CHP lock-out. And the needs of the consumer must of course be studied, which points, again, to the potential role in CHP for energy service companies.

What difference will a liberalised and restructured market make to the prospects for CHP? It can be argued that in a competitive market the deciding factor will be prices, and that the cheapest generation options will be the winners. Long-term, liberalised markets will favour the most efficient generators. It will be claimed by many that the shake-down in a de-regulated, liberalised market will be, in any case, the testing ground for CHP, as for any generating option; and that we should allow the survival-of-the-fittest principle to do its job and eject the least economical players. It is tempting here to wonder if this would not leave us with the undesirable survival of the biggest or the oldest. Is this what we want? To avoid such unwelcome outcomes -- in the short term at least -- we need appropriate regulative frameworks to ensure that the forces of price competition do not subordinate the solutions that offer better environmental and economic benefits for the medium and longer term. Here again, we have to be vigilant over keeping the market open to tomorrow's next-generation of climate-friendly technologies.

At all events, the full picture regarding de-regulation is not yet clear. True, some impact is already being felt, such as downward trends in electricity prices due to over-capacity inherited from the old monopoly system. In some countries, this is even forcing local CHP plants out of business, which bodes ill for the creation of new CHP facilities. But we are still in the throes of a very far-reaching process of change in the energy markets and foreseeing the outcome for cogeneration – or indeed for any generation option – with any precision is impossible. What we cannot afford to do, however, is sit on our

hands and wait, which could mean sitting and watching CHP being squeezed out of the market by narrow, short-term economic considerations. Why not?

First, co-generation offers fuel efficiency of some 80% and therefore significant greenhouse-gas reductions potential, so there is an urgent need to give it a maximum chance in the market. As I have already observed, there is a danger of seeing CHP being elbowed out of the investment market by the traditional power generation technologies, often involving large-scale installations that offer more attractive short-term returns. At the risk of repeating myself, I would stress how important it is to consider investors' psychology. The pay-back time for a co-generation plant can be long, whereas fast returns can be expected from outlay on a traditional-technology power generation facility. It is easy to see why an investor might prefer the short-term option to the longer-term one, even though the short-term option may be more risky than the more secure long-term investment. The real cost of CHP, it can be argued, is higher (including the risk factor) than that of other means of generating electricity at lower risk, which explains the low take-up. But it is precisely this that effective policies can address, and those policies should also take into account the overall environmental benefits of CHP, in other words, internalise the externalities. What we have here is a classic case of market failure, and one not specific to CHP, but one nevertheless in which CHP will be vulnerable because of market uncertainty.

The second reason concerns the long-term issue of fuel choice. One of the key advantages of cogeneration is that it is still in the process of entering the market now – albeit with difficulty. These cogeneration facilities are therefore based on new technology that can incorporate adaptability for using a diversity of input fuels. Fuel diversification can shelter any power-generation unit from the unpredictable fluctuations in fuel prices that a liberalised energy market is likely to create. But, crucially, it also offers environmental and cost-effectiveness

benefits. Co-generation has already seen a major switch from oil to natural gas, and biomass-fuelled CHP clearly has a big future. It is becoming a choice option in Sweden and Finland.

That being said, it is equally true that CHP is not a power-supply solution that is universally applicable, whatever the degree of market de-regulation. Country-specific and climate-specific factors have to be taken into account. For example, local fuel supply solutions can work in its favour; we have seen that readily available supplies of wood have made wood-fired cogeneration an ideal option in Canada or in Finland. Climatic conditions and urban-heating requirements are also crucial. And the actual size of the country and its population density can determine whether distributed power through numerous local power plants is more viable than centralised power production units. Whatever the case, distributed generation resources are likely to be in greater demand in many countries as a result of restructuring in the electricity markets, and small, efficient CHP generation plants installed locally will constitute an increasingly appealing option to respond to that growth in demand.

The two-fold nature of CHP's output is another interesting factor that merits careful consideration. One might be tempted to regard the heat element in the cogeneration process solely as a by-product that can be marketed profitably and thus reduce overall costs. The question can also be considered in reverse – as is often the case in industry – and the focus placed on where heat (or cooling) requirements lie. It would be good to see this approach adopted on a more widespread basis. Market barriers have hitherto made it difficult to sell the co-generated power to the grid or other customers and thus rendered CHP impracticable in many instances. Is there not a large potential to be exploited by seeking out the market opportunities for the heating (or cooling) portion of the cogeneration output and matching the electricity production to that heat load?

We should not forget that the CHP infrastructure needs to be in place so that it can be exploited to the full once the de-regulation and liberalisation process has done its work and the full picture regarding cost-effectiveness emerges. The small-scale Independent Power Producers have a definite role to play in the newly forming markets.

What role does the International Energy Agency play in fostering suitable market conditions for CHP? We certainly see the cogeneration option as one of the key technologies that can be promoted by domestic policies and measures to bring us closer to meeting the Kyoto commitments, also to meeting our energy security requirements. The fact that the markets are not currently proving hospitable to CHP is no reason to dismiss the fact that this technology can make a major contribution to ensuring cost-effective, medium and long-term secure supplies of environmentally friendly energy.

The IEA is also involved in promoting the development of cogeneration technologies through its Implementing Agreements, or international collaborative projects, notably those dealing with district heating and cooling, with the dissemination of information on energy efficiency technologies (CADDET), and with bio-energy technologies. This international programme for collaboration on energy technology research and development brings together 33 countries, including 11 non-IEA nations, and the European Commission. They work jointly on developing technologies in a wide range of energy-producing and energy-consuming domains. By working collaboratively they avoid duplication of effort, cut costs and speed progress towards more economical and environmentally benign technologies. These Implementing Agreements collectively link about 500 contracting parties, chiefly government and private research institutes world-wide, which mobilise over \$120 million

annually to develop numerous advanced and more efficient energy technologies and to disseminate information on them. Non-Member countries participate in some of these programmes.

I should like to say a word here about the need to seize the attractive opportunities that exist now for co-generation plants at a time of transition and rapid development outside the industrial nations. The developing nations are of course very much in the limelight when we consider the climate-change issue. The increase in CO<sub>2</sub> emissions from China and the rest of the developing world between 1995 and 2010 have been projected at three-quarters of the total increase for the world as a whole. We should not forget, moreover, that the CO<sub>2</sub> threat will not disappear after the 2010 Kyoto deadline; it will actually intensify as the developing world industrialises.

Cogeneration facilities are already a regular feature in many of the transition economies, for example in the Baltic Sea Region, where district heating supplies more than 40% of space heating in the residential and service sectors. The advances to be made there chiefly concern refurbishment and expansion of existing plants. But in countries that are less far along the path to industrialisation, cogeneration is a choice option because its energy-efficiency and climate-friendly features can help these nations side-step the costly and energy-intensive stages of industrialisation. Cogeneration is also an ideal solution for sparsely populated areas. It is encouraging to see that the International Cogeneration Alliance has two new corporate members from India, and that the Chinese Society of Electrical Engineering is to be represented on the Management Board of the Alliance.

Climate concerns are naturally one of the many motivations underlying the IEA's interest in seeing a level playing field for CHP. A recent manifestation of this interest is the analysis spotlight that the Agency is now placing on CHP.

The project's point of departure will be the following observations:

- CHP is widely considered – depending on country-specific circumstances – to be one of the most cost-effective technologies for reducing greenhouse gas emissions.
- The market penetration of CHP is disappointing.
- What is going wrong in our attempts to meet the targets?
- Where do the problems lie? In the targets? Or in our performance in meeting them?

Eliminating the barriers is only half the job and we need to pave the way to more widespread implementation of CHP beyond those barriers. The aim is to foster competitive implementation of the cogeneration option rather clipping the wings of competing alternatives. It is a question of exploiting the possibilities of current trends rather than attempting to reverse them.

The study will analyse strategies, policy statements and measures taken in relation to CHP in IEA Member countries and elsewhere, with a view to identifying problem areas and suggesting remedies. The added value will come from the global focus that IEA is able to bring in comparison of approaches and evaluation of experiences.

It is fair to say, I think, that the International Energy Agency is taking a proactive position in the crucial challenge of establishing fair-play conditions for CHP. We are not in favour of influencing decisions against market forces. We



are convinced that the most productive solution is to exploit market forces to the full, and thus avoid market failures. If I had to choose one single message to convey today it is this: the key to success in expanding CHP generation lies in establishing a level playing field for both existing and future market participants. Government policies need to be fully compatible with free markets to achieve goals that may not be attained by markets alone.

Thank you, ladies and gentlemen, for your attention.